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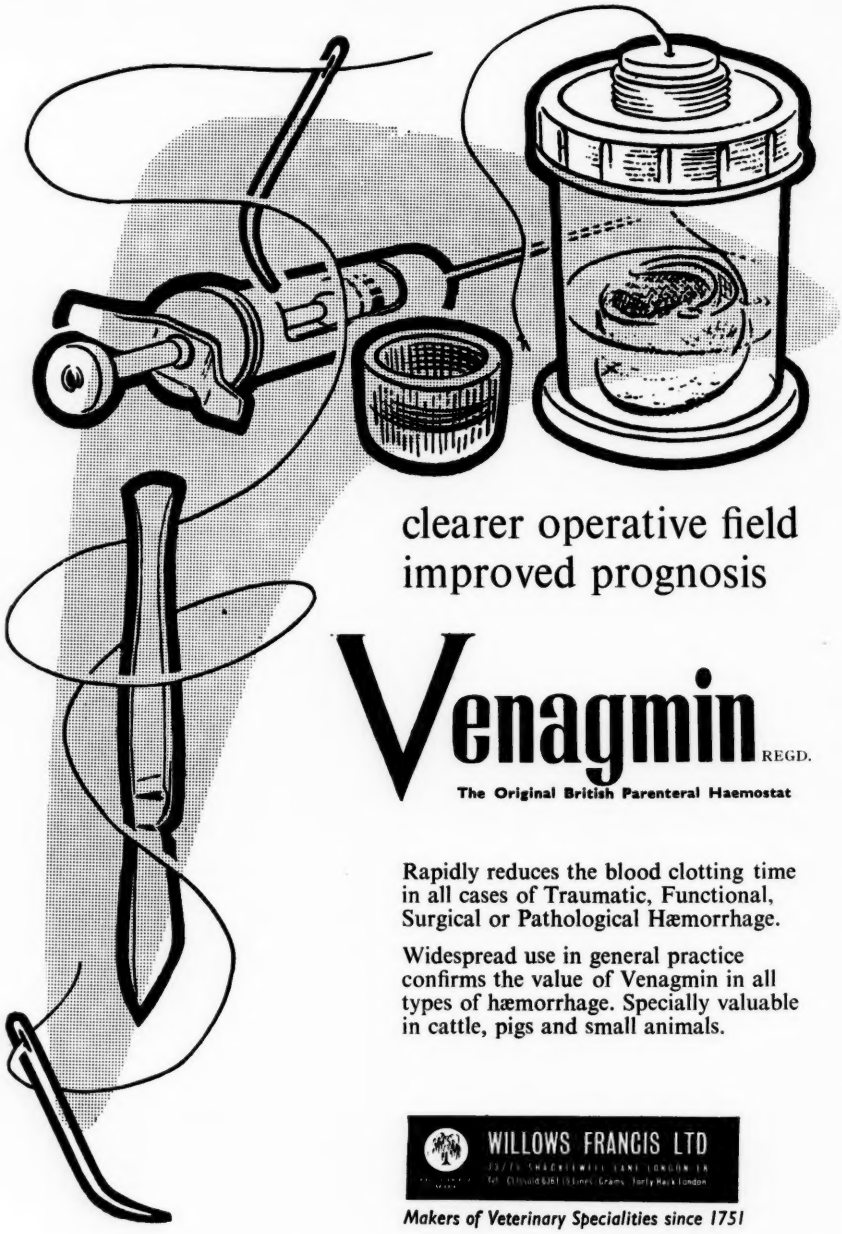

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EDITORIAL

DOGS AND MEN

WHEN the dog crept into prehistoric man's shelter and surrendered the questionable joys of complete freedom, and his right to maintain a precarious existence fraught with fear of his enemies and an ever-present anxiety with regard to food and shelter, he showed that he was a very sagacious beast. He was a diplomat worthy to rank with the greatest of those who exercise their talents in the international political field. He was full master of the art of compromise, prepared to give way on small things as long as the major factors could be assured. He agreed to serve his master faithfully, to help him in the search for food, to protect his property, and to cherish his family, in return for an adequate share of the spoil and a good dry bed. In the first instance no doubt the arrangement was founded on strict economic design but, when it was accepted and he felt assured of the reasonable permanence of his new and salubrious state, the dog, taking stock of the sentient emotion of man, began to consider and assess the further rewards that might follow the judicious exercise of a little flattery and charm. He turned his soft deep eyes upon his friend, he snuggled to his side, he paid regard to him above all others and, hey presto, his victory was complete.

It was not long before the hireling was in command and the master had fain to prepare his food, to comb his hair and even catch his fleas. When Bo Bo discovered roast pork and revelled in its gorgeous aroma and delectable taste the news spread far and wide and soon there were many who shared his joy. So it was with dogs when they discovered the tender heart of man. Clever dogs could lie and snooze in the sun without a care for the morrow. Dogs fraternize with man and share his table in all parts of the world but in no place have they advanced their situation to a greater degree than in the British Isles. By their arts and wiles they have displaced the sacred horse in the British natives' affections. They have acquired a proud form and an aristocratic demeanour, they command from their

owners all the respect and attention consistent with their exalted status, and the hospitality which was craved in cringing stance long years ago is now demanded and accepted as a right. And all this has come about with great degree of mutual benefit and all concerned are happy and satisfied. Clever dogs proclaim and demonstrate their love and respect for man and this is reciprocated in full measure. So that the master's interest and affection may be maintained and enhanced dogs, emulating the arts and crafts of woman, have devised a series of remarkable changes in their form and their way of life. The variety of their hirsute decoration is infinite and like that of Eve calculated to appeal to the discerning human eye.

By the wiles of the canine race we have come to the stage when man and dog are completely complementary and life would lose much of its charm if one was divorced from the other. Dogs are great flatterers, they are loyal and are not influenced by rank or degree. To his dog a dustman comes before a king. Psychologically their companionship and love has brought comfort to many a sad heart and lonely soul, as was exemplified times out of number during the dire days of the World Wars I and II.

As February comes round so does the dogs' great day, Cruft's Show. This year nearly seven thousand dogs and ten times that number of humans gathered together in Kensington. In some measure the occasion will savour of a mutual admiration society, but this is only one side of the picture. A great industry has grown up around the dog. Thousands gain their livelihood in attending to his wants. British dogs are the best in the world and last year dogs to the value of £750,000 were shipped abroad.

There are some veterinary surgeons who are apt to scoff at small animal practice and speak with disdain of their colleagues who follow that line of life. This is a stupid attitude for humane reasons demand veterinary service, financial reasons compel it and it is completely justified also on psychological grounds.

GENERAL ARTICLES

THE RELATIONSHIP OF HEPATIC NECROSIS TO THE APPEARANCE OF JAUNDICE IN CANINE VIRUS HEPATITIS

By G. SKULSKI

Canine Research Station of the Animal Health Trust, Kennett, Near Newmarket, Suffolk

Introduction

CASES of Canine Virus Hepatitis exhibiting jaundice are rare although the liver is always affected. This aspect must be considered when one discusses the relationship of jaundice to the underlying hepatic lesions. The present study was undertaken in order to analyse the histopathological details of the liver lesions in Canine Virus Hepatitis and to determine which features could be correlated with the presence of jaundice.

Materials and Methods

Histopathological examinations of liver specimens from 24 fatal cases of Canine Virus Hepatitis were made. Eleven of the dogs had been inoculated experimentally with the virus (Parry, Larin and Platt, 1951) the others, thirteen, were submitted by veterinary surgeons for post-mortem diagnosis. In the experimental group of dogs, jaundice was observed in six cases and in the other group jaundice was present in one case only. Intranuclear inclusion bodies were found in ten of the inoculated dogs and in all cases from the other group.

The fixative used was neutralised 10 per cent formol saline. The sections were stained with hæmatoxylin and eosin, Best's carmine stain for glycogen and Gordon Sweet's reticulum and impregnation method. Other techniques used were Forsgren's stain for bile acids, Stein's for bile pigments, Sudan 1v and Sharlach R for fat, Dieterles for spirochætes and Prussian blue for hæmosiderin.

Histological Findings

In general, the histopathological changes in all cases were those specific for Canine Virus Hepatitis. Intranuclear inclusion bodies, parenchymal cell degeneration, coexistent inflammatory reaction with evidence of severe vascular damage were noted. A comparison between the histopathological changes found in icteric and non-icteric types of the disease is set out in the following table.

Jaundice	No. of cases	Necrosis			Bile thrombi	Vascular damage	Intra-nuclear inclusion bodies
		Centri-lobular extending to the periphery	Centri-lobular only	None			
Present	7	6	1	0	3	7	6
Absent	17	0	7	10	0	17	17

It can be seen from the table that in six of the seven cases exhibiting jaundice

the centri-lobular necrosis had extended to the periphery of the lobules; whereas in the seventeen cases showing no evidence of jaundice no peripheral necrosis was demonstrated. Icterus in the one case showing only centri-lobular necrosis may have been associated with the presence of bile thrombi which were very numerous.

Discussion

There is evidence in the table that histopathological features of the liver show some correlation with the occurrence of jaundice in canine virus hepatitis.

Extensive loss of parenchymal hepatic cells due to extensive centri-lobular and peripheral necrosis has been well marked in six icteric cases out of seven. It may be presumed that there are insufficient functioning cells to deal with the circulating bilirubin. Jaundice seems to be dependent upon the extent of the lobular necrosis and occurs when the centri-lobular necrosis has extended to include the parenchymal cells on the periphery of the lobules.

In the present series, well marked portal inflammatory changes and associated swelling of small bile ducts as well as prominent necrosis involving bile ducts and canaliculi have been found in six out of seven cases. These lesions were not observed in the non-icteric cases.

Acknowledgements

I express my thanks to Mr. W. B. Singleton for his helpful criticism in the preparation of this paper, and to Mr. C. F. Hart and Miss J. Morley for preparation of the histological sections and microphotographs.

REFERENCE

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TETANUS IN A CAT

By G. E. KODITUWAKKU and E. A. WIJEWANTA

Department of Veterinary Science, University of Ceylon

TETANUS in cats is extremely rare; only five cases have been recorded, as far as can be ascertained, Fildes, Hare and Wright (1931), Bateman (1931), Hopson (1932), all in Great Britain, Ludins (1939, in U.S.A., Letlow (1955) in Germany). Only Fildes *et al.* made a bacteriological examination and isolated *Cl.tetani* Type III.

The explanation of this rarity of tetanus is cats is primarily the marked resistance of cats to *Cl.tetani* toxin; Fildes (1929) showed that the cat is 2,400 times more resistant than the horse. Topley and Wilson (1948) state that the cat is 600 times as resistant as the mouse which in turn is 12 times as resistant as the horse. An additional explanation of the rarity of tetanus in the cat lies in the ability of the cat to lick any wounds.

In Ceylon, tetanus is not uncommon in human beings and in animals, Seneviratna and Pillai (1953) recorded three cases in dogs and several other cases have been treated in the Government Veterinary Hospital, Peradeniya. Cases of tetanus in goats are quite common and a case in a monkey (Macaca (Zati) Sinica Sinica) has been observed (Kodituwakku, 1956).

PLATE I

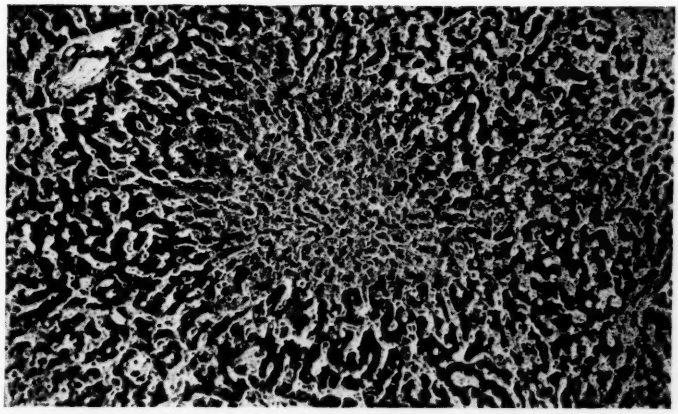

FIG. 1
Centrilobular necrosis from a non-icteritic case of C.V.H.

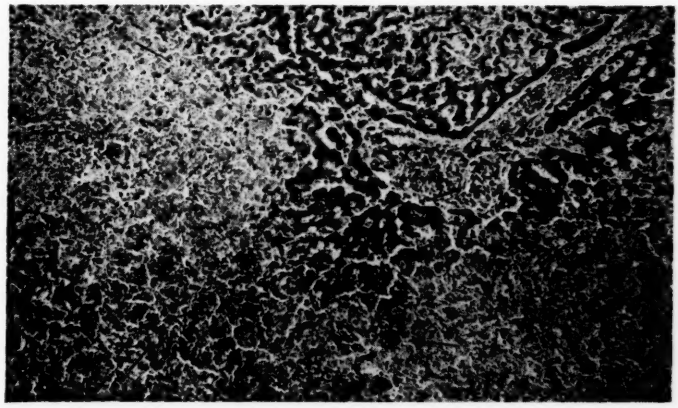

FIG. 2
Necrosis extending to the periphery of the hepatic lobules from a case of C.V.H. exhibiting jaundice.

(*Article by G. Skulski on page 47*)

PLATE I

FIG. 1
24 hours after onset of symptoms.

FIG. 2
Shows the nictitating membrane drawn over the Cornea.

(Article by G. E. Kodituwakku and E. A. Wijewanta on page 48)

A fatal case of tetanus in a cat is thought worthy of note. It was a male, entire cross-bred cat, 5½ lb. in weight and about 2½ years of age.

History and Symptoms

Signs of illness in the cat were noticed by the owner on 27.1.57 (the day before it was brought to the clinic). Stiffness of the muscles and joints of all the limbs was evident (Fig. 1). This was more marked in the limb on which a recent wound was found. The wound was on the plantar aspect of the right hock and penetrated into the gastrocnemius tendon at its insertion on to the calcaneous. The owner was unable to say when and how the wound had been inflicted.

Increased reflex excitability to touch, light and sound was very pronounced. The pupils were contracted to a slit of about 2 mm. in breadth but they gradually dilated to 4 to 5 mm. during the following two days. The nictitating membranes were paralysed (Fig. 2). No trismus was present and the animal was able to take milk when fed with an ink dropper.

Treatment etc.		
28-1-57—Temperature	98.8°F	10,000 I.U. Tetanus Antitoxin intravenously.
Respiration	24/mt.	6 mg. Largactil intramuscularly.
Heart rate	112/mt.	600,000 Units Diamine Penicillin.
		Glucose Saline per rectum every 4 hours.
29-1-57—Temperature below	95°F	Glucose saline as previously with 10 grains Mag.
Respiration	21/mt.	Sulph. p.r.
Heart rate	88/mt.	
30-1-57—Temperature	98.8°F	6 mg. Largactil I.M.
Respiration	40/mt.	Glucose saline and Mag. Sulph. as previously.
Heart rate	100/mt.	

The cat died on the night of the 30th of January. A post-mortem examination the following morning did not reveal any specific pathological lesions.

Bacteriological Examination

Before treatment was begun on 28.1.57 the scab over the right hock was excised and the necrotic tissue and pus distributed in five tubes of freshly boiled Cooked Meat Medium. After three days there was a profuse growth with gas bubbles and a putrefactive smell. Films stained by Gram's method revealed numerous slender terminal sporing organisms (spherical and oval spores) also numerous cocci and stout gram positive rods.

Mouse Inoculation

Two white mice were inoculated intramuscularly with 0.25 c.c. of culture, from one of the five Cooked Meat Media tubes which showed the largest number of terminal sporing organisms. As a control two other mice were inoculated intraperitoneally with 1,500 I.U. of Tetanus Antitoxin (Wellcome Brand) each, an hour prior to the inoculation of 0.25 c.c. of culture fluid.

Signs of tetanus developed in the two mice which were given only the culture fluid 30 hours after inoculation. They died one hour after the onset of symptoms.

The two protected mice did not show any signs of tetanus.

Summary

A case of tetanus in a cat in Ceylon is described. The literature on tetanus in cats is reviewed. Five cases only, as far as the authors are aware, have been

recorded previously. The records show that *Cl.tetani* was recovered in only one instance. In the present case, *Cl.tetani* was recovered from a wound on one of the legs.

Acknowledgements

We are grateful to Professor C. A. McGaughey, Dean of the Faculty of Agriculture and Veterinary Science, University of Ceylon, for his help and guidance and also to Mr. A. W. N. Moses, Department of Veterinary Science, University of Ceylon, for the photographs.

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CONGENITAL DEFORMITY OF THE TAIL IN PIGS

By N. H. BROOKSBANK

Veterinary Investigation Centre, Liverpool

DEFECTS which are inherited and result in mortality or inability of the animals to lead a normal life are important. It may be necessary to take measures to eliminate the strain of species which is affected with the defect.

As regards the domestic animals, there are very few recorded cases of defects of the vertebral column associated with hereditary factors. Mohr and Wriedt (1930) described a condition in calves in which the body was shortened considerably though the extremities remained normal. The calves were born at full time and were either stillborn or died shortly after birth. Examination of the vertebral column showed that apparently there was a considerable reduction in the number of vertebræ. This resulted from irregular fusions and amalgamations of adjacent vertebral rudiments during their development. The calves were amongst the offspring of a particular bull and the lesion appeared to be due to a recessive lethal gene.

Donald (1949) studied the results of mating pigs which carried the genes of kinky tail. The affected pigs had normal vertebræ except that the coccygeal bones, which often were reduced considerably in number, always terminated in a fused mass.

The present paper reports an investigation into the history of a pathological condition of two piglets from different premises and unrelated stock which showed inco-ordination of the hindquarters and defective tail development. One piglet had a very rudimentary tail and came from premises where piglets in other litters had been born with either defective tails or no observable appendage (Case 1). The

second piglet came from a farm were it was the only one known to have been born without a tail (Case 2).

Case 1: History of Herd

A farmer purchased a pure-bred Large White boar with the view of improving the stock-line of his commercial herd. During the course of the following twelve months a number of females mated to the boar produced litters in which there were individuals with no tails or only a rudimentary stump. Most of the tailless piglets were unable to walk and they died either from undernourishment or they were killed shortly after birth. The average number in the litters varied from 6 to 8 piglets. In view of the unsatisfactory results obtained the boar was returned to the vendor and almost all of the survivors of the tailless litters were reared for bacon. Subsequently the same breeding animals were mated to fresh boars and no more abnormal litters were born.

Six apparently normal gilts, survivors of litters in which there had been tailless piglets were taken to new premises. They were mated to a boar purchased from the previous tenant of the farm. Twelve months later another boar, unrelated to the six gilts, was purchased and they were mated to him. Similar litter results were obtained from both boars and three distinct groups of litters were born.

Group A. Two of the gilts consistently produced normal litters of 10-12 piglets. One gilt had five litters up to the time of this investigation and the other had three litters before she became ill and was destroyed.

Group B. Another two of the gilts each produced four litters consisting of 6-8 piglets and always one, sometimes two, of these had rudimentary tails. They were destroyed for they had difficulty in moving their hind limbs. The specimen received for examination was from a litter farrowed by one of these two dams.

Group C. The remaining two of the six gilts produced litters of 6-8 piglets also, but each litter contained three or four piglets without tails. Both dams were slaughtered after each dam had produced two such litters to the first boar and one litter to the second boar.

The owner stated that all the defective piglets had great difficulty in standing upright as the hind legs lacked muscular control. Often piglets would lie down with the legs splayed out backwards. No normal tails were discernible and in the sacral area of the defective piglets from Group C the skin appeared semi-transparent and a vague outline of the rectum could be seen. Digital pressure in the area met with no resistance and there was a depression on the skin as might be expected if no bone structure was present.

Post-mortem Examination of Affected Piglet

The piglet was a Large White boar. It was one of two in a litter of eight born with very rudimentary tails and farrowed by one of the two sows of Group B. It was one of the smallest members of the litter and it was killed within 24 hours of birth.

The piglet had shown difficulty in moving its hindquarters as the legs were held very rigid.

General Appearance

Externally the piglet appeared normal except for the lack of a tail which was

replaced by a short appendage of the skin in the shape of a drumstick, half an inch in length and one-eighth of an inch in diameter at the base. It protruded from the skin about three-quarters of an inch anterior to the normal site for the tail to commence. The appendage contained no bone or cartilagenous structure but consisted of a fibrous core which, on dissection, passed through the skin down to the sacrum. The sacral area offered no resistance to digital pressure and one gained the impression that there was little cartilagenous or osseous tissue in that area.

Macroscopically the limbs, head and all the internal organs including the urogenital tract were normal.

Examination of X-ray plates (Figs. 1 and 2) showed that there was any defective bone structure only in the vertebral column. Dawson's (1953) technique for showing calcification of bone of small vertebrates was used but it was modified in that most of the muscle tissue was removed, no defating was done and the specimen was left in Solution A for three weeks. By this method the bone stained red and the other tissues became transparent so that it was possible to observe, with great clarity, the abnormalities that were suggested on the X-ray plates.

The Vertebral Column

The cervical vertebræ were normal.

In the dorsal area the spinous processes and neural arches of vertebræ 2 with 3 and 6 with 7, 8 and 9 were fused. It was in the latter area that a defect in rib development was noted. Fifteen ribs were counted on the left flank but only fourteen on the right. The first five ribs were in pairs but in the area related to the fused vertebræ there were four ribs on the left, with two of the ribs apparently attached to vertebra six, and there were three ribs on the right side (see diagram).

Patten (1943) described the body or centrum of the vertebra as having one centre of ossification, while Sisson (1938) noted that sometimes there were two centres which soon fuse. With the modified Dawson technique used on this specimen the majority of the bodies of the vertebræ were found to have bilateral or abnormal sized areas of calcification and were probably in fact the areas in which ossification originated. A normal day-old pig showed only one area of calcification in the body of every vertebra. With regard to vertebræ 2 and 3 which had fused spinous processes, the body of 2 had two areas of calcification, which apparently were fused together while in vertebra 3 the two areas were separate and differed in size. Vertebra 5 had two areas in close proximility. The spinous processes of 6, 7, 8 and 9 vertebræ were fused and the bodies showed marked abnormalities in the number and size of areas of calcification. Taking the areas of calcification of the bodies of vertebræ 1, 4 and 10-14 as normal then that of vertebra 6 was small and positioned on the left side. The body of vertebra 7 was larger than that of number 6 and also on the left side. Vertebra 8 had two small detached areas with that on the right side being smaller than the one on the left side which in turn was about the size of the area of the body of vertebra 6. Vertebra 9 had a large central area of irregular size. Vertebra 15 had two separate areas of calcification with the right side area being about half the size of that on the left which was about normal for its half of the calcified area (see diagram).

Examination of the lumbar vertebræ suggested that an attempt had been made

PLATE I

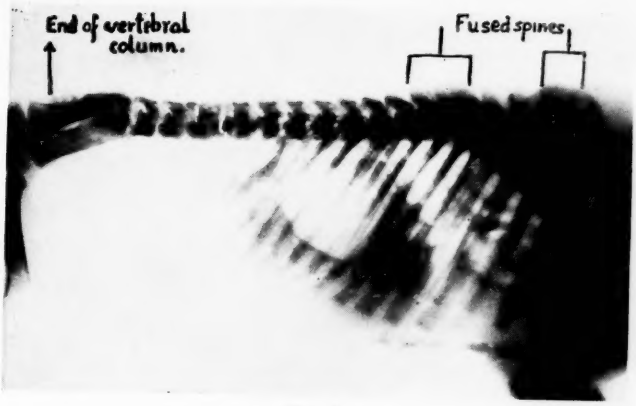


FIG. 1
X-ray of left side. Case 1.

FIG. 2
X-ray from dorsal aspect showing the abnormal dorsal, lumbar and sacral vertebræ. Case 1.

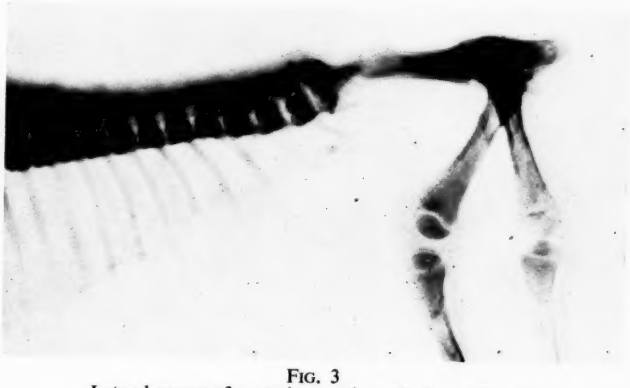


FIG. 3
Lateral aspect of posterior portion of spine. Case 2.

(*Article by N. A. Brooksbank on page 50*)

PLATE II

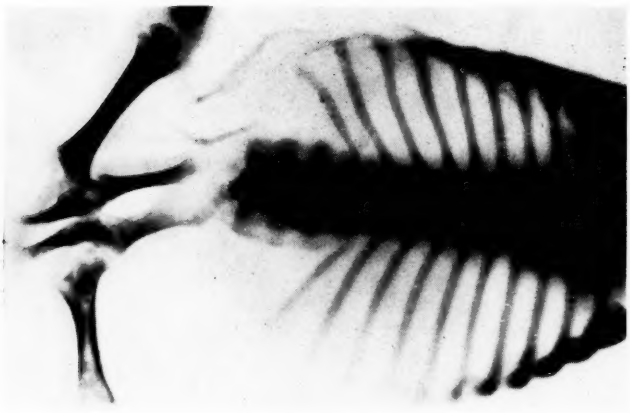
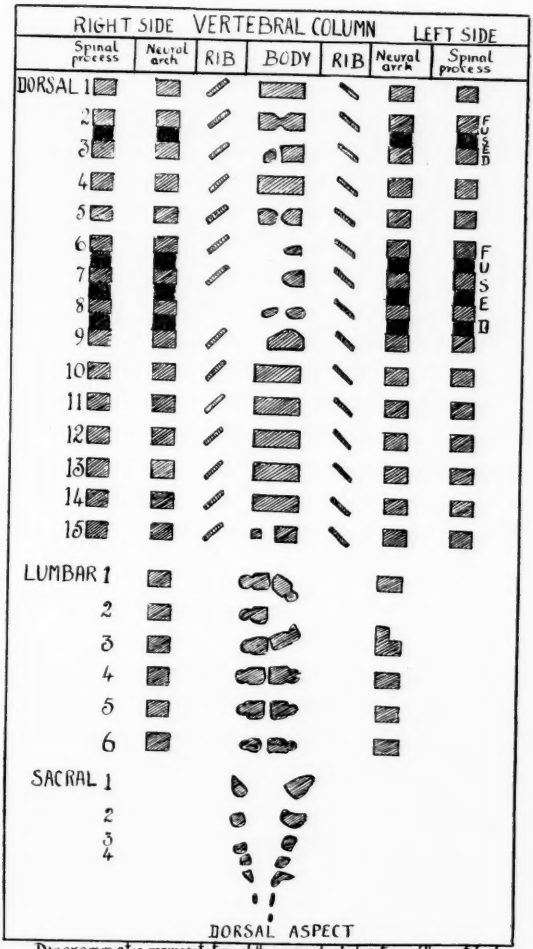


FIG. 4
Dorsal aspect of vertebral column. Case 2.

FIG. 5
Dorsal aspect of vertebral column of a Manx kitten.

(Article by N. H. Brooksbank on page 50)

PLATE III



Diagrammatic representation of the areas of calcification of the vertebral column as observed by the Dawson technique Case 1.

(Article by N. H. Brooksbank on page 50)

XUM

to rectify the larger number of ribs and calcified areas of the bodies of the dorsal vertebræ by a reduction in the number of the lumbar bodies on the same side. Thus lumbar 2 had only calcified on the right side whilst the body and neural arch of lumber 3 had an extension protruding forward on the left side. All the lumbar bodies except number 2 had two areas of calcification. Vertebra lumbar 6 appeared to have tried to rectify the large area of calcification of the body of lumber 2 by having a small area of calcification on the same side. As a result of this peculiar development of the lumbar bodies a marked curvature of the spine was produced.

The four sacral vertebræ were widely separated, variably shaped, had small sized calcified bodies and only the first two neural arches showed any calcification.

One pair of neural bone structure areas together with three fragments apparently represented the very abbreviated coccygeal calcification. Two of the minute fragments were paired and from their position in relation to the pelvic bones might almost be considered as pair 6 of the sacral bone.

Case 2: History of Herd

A Landrace gilt purchased in-pig produced a litter of 13 in which 4 boars had scrotal hernia. Subsequently she was served by a two-year-old Landrace boar which had been reared on the farm and had served several females with satisfactory results over a period of twelve months. In the resulting litter of nine there was one pig with a scrotal hernia and another without a tail. Both the boar and the gilt were indirectly related through their grandsire.

The tailless pig was unable to move its hind legs though by using its forelegs it could drag itself about the pen and get some nourishment from the dam. On the fourth day it was very weak and died.

General Appearance

The piglet, a female, was of average size. There was no evidence of a tail and palpation of the sacral area indicated that the vertebral column terminated anterior to the pelvis.

The head and limbs were normal in appearance. The reproductive tract and all the internal organs were normal except that the rectum and colon were distended with fæces. The bladder was not unduly distended though the ureters were dilated, particularly the left one, and there was a quantity of fluid in the pelvic cavities of the kidneys but there was no evidence of cystic formation in these organs.

Vertebral Column

Dissection of the vertebral column and examination of X-ray plates (3 and 4) showed that the ribs were paired evenly and there were no fused masses in the spinous processes of the dorsal area. The two anterior lumbar vertebræ were normal. Although the greater part of the third bone was present it tailed to a blunt point. Beyond the third bone there was neither bone nor cartilagenous structure.

Discussion

A careful study of the animals on both farms and of the diets being fed, particularly to the pregnant sows, did not suggest there was a mineral or vitamin deficiency which could be responsible for the abnormality observed.

The history and examination of the specimen (Case 1) showed that abnormal

development occurred in various parts of the vertebral column, particularly in the posterior portion. These lesions were observed in a piglet from Group B in which one or more animals had very rudimentary tails. It is possible that the development of various parts of the vertebral column in the affected piglets from Group C, in which there was no vestage of a tail, was even more defective.

The second pig examined (Case 2) probably resembled clinically the piglets of Group C of Case 1 rather than the piglet of Group B but on post-mortem examination there was no evidence of an extensive abnormal development of the vertebræ; instead there was a complete lack of spine formation in the posterior portion.

Examination of the published X-ray photographs of a condition described by Donald (1949) as " kinky tail " did not indicate any defective bone development of the vertebral column apart from the fusion of some of the coccygeal bones. Along with the abnormal tails, Donald also observed defects of the head particularly the snout, of the uro-genital tract and the absence of leg bones. None of these lesions were seen in the specimens described above and information from the owners did not suggest that they had observed head or leg abnormalities in any of the other members of the litters.

Mohr and Wriedt (1930) described a hereditary defect in calves in which there were lesions of the head and limbs similar to those reported by Donald but without vertebral or urogenital tract defects. Specimens of a litter of pigs with defective head and limb development but without kinky tails or urogenital tracts have been examined at the laboratory. These specimens were obtained from Mrs. R. C. Bisbee who had been doing some selective breeding with a sow and a boar. It would seem that the piglets described by Donald had a number of genetic factors contributing to the production of the defects observed. The history of Case 1 suggests that one gene was involved and that it was dominant.

In another hereditary defect in calves reported by Mohr and Wriedt, the spine was greatly shortened, presumably due to irregular development, and fusion of various ossifying centres. Many of the ribs were fused and they were reduced in number to about eight pairs. In spite of these irregularities the coccygeal bones were evident in all specimens and the tail was relatively normal in length. In this instance a spinal defect was observed which differs completely from those seen in the two piglets here described.

Bisbee (1956) has studied the vertebral column of the Manx cat which has little or no tail. She found that when two very stumpy tailed Manx cats were mated often the progeny were unable to move their hindquarters. Examination of the vertebral column of these kittens showed that the majority of the sacral bones were absent and there was defective development in other areas. Three Manx kittens which had been destroyed because of their inability to use their hind legs have been examined and showed, on dissection and X-ray examination, a lack of development of the coccygeal, sacral and some lumbar vertebræ such as was observed in the Landrace pig (Case 2). In the kittens the last lumbar vertebra was incomplete. This was observed also in the pig (Fig. 5).

It is of interest to note that the Landrace dam of Case 2 had a normal tail; that with her first litter she produced four boars with scrotal hernia, and with her second litter to a different boar, though it was related to her, there was one male with a

scrotal hernia and one tailless pig. On being mated to the second boar again this dam subsequently produced ten piglets, all of which are perfectly normal.

Summary

An examination of the vertebral column of two piglets with defective tails from different breeds of pigs has been made and quite different abnormalities have been observed. In one piglet there were irregularities in the development of the sacral, lumbar and dorsal bones while in the other piglet there was a complete lack of formation of vertebræ in the lumbar and sacral areas. The histories of the herd suggest that the defects in development observed were of hereditary origin. A comparison is drawn with the transmissible tail deformity of cats as seen in the Manx breed.

Acknowledgements

I wish to thank Mrs. Bisbee (late of University of Liverpool) for all her helpful criticisms, Mr. G. Weston (Veterinary Pathological Department, University of Liverpool) for the photographs and preparation of the specimen by Dawson's technique, and the Veterinary Hospital, University of Liverpool, for the X-ray plates.

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THE EFFECT OF HIGH LEVELS OF VITAMINS ON THE SUSCEPTIBILITY OF CHICKENS TO SALMONELLA GALLINARUM INFECTION

L. G. CHUBB, R. F. GORDON and J. F. TUCKER

Houghton Poultry Research Station, Houghton, Huntingdonshire

Two recent reports (Hill *et al.*, 1955, Hill and Garren, 1955) suggest that high levels of all the known required vitamins increase the resistance of New Hampshire Red and White Rock chickens to *Salm. gallinarum.* At the time these results were published a series of experiments had been planned to study at the Houghton Poultry Research Station the effect of certain vitamin deficiencies on the susceptibility of chickens to this infection, and to include a reinvestigation of the work of Hill and his co-workers, using a British-type basal diet.

Some of the variables met with in investigations concerning nutrition and infection have been summarised by Parry (1948), the most important being the host, its nutritional status, the character of the infection and the nature of the suspectibility (or resistance). In poultry such studies are complicated by the great variety of the response of individuals to dietary and infectious influences. Hutt and Scholes (1941) have demonstrated that significant differences occur among breeds in their susceptibility to *Salm. pullorum.* This resistance may be of genetical origin (Roberts and Card, 1935) and De Volt *et al.* (1941) claimed to have produced pullorum-

resistant chickens by selection. Smith (1956) has shown that considerable variation can occur between batches of chickens of different breeds in their susceptibility to experimental *Salm. gallinarum* infection and he noted also that whilst this variation is mainly a function of breed, variation can occur between batches of different origin of the same breed. Ram and Hutt (1955) have shown that a physiological basis for this difference exists in that the resistance of White Leghorns to *Salm. pullorum* may be due partly to their higher body temperature at between one and five days of age and their superior thermal regulation and control compared with heavy breeds. In addition, lymphocytes may play some role in this resistance mechanism, their percentage in the differential smear tending to be higher in the White Leghorns than in heavier breeds.

Ross and his co-workers have recorded the biochemical changes which can occur in the pullorum-infected chicken (Ross *et al.*, 1955a, b; Ross *et al.*, 1956; Gilfillan *et al.*, 1957). This infection can alter the normal metabolic pattern of arginine considerably and evidence is presented that an imbalance of the tricarboxylic acid cycle can increase susceptibility to this pathogen.

While it would appear desirable to standardise the genetical constitution of the host in experimental studies of this nature, this can be done by using highly inbred strains only. This has not been possible in the experiments reported in this paper.

Smith (*loc. cit.*) has clearly shown the importance of the age and stage of growth of the host, at the time of infection, on the mortality rate of chickens experimentally infected with *Salm. gallinarum*.

Finally, the standardisation of the infection is as important as standardising the nutritional situation, and it is important to define, as precisely as possible, not only the number of organisms, but their virulence and general biological characteristics within the host, as well as their site of entry and any ancillary aids to their establishment such as the environment of the alimentary canal.

It is against this background of many factors which can influence the susceptibility to disease that the following studies have been carried out. Three different breeds of chickens of known susceptibility to experimental *Salm. gallinarum* have been used, and rearing and other management factors standardised as nearly as possible. The procedures described by Smith (1955) have been followed closely, especially the classification of survivors on the pathological basis.

Materials and Methods

Chickens. Pure Brown Leghorn, White Leghorn and Rhode Island Red chicks (males and females in approximately equal numbers) were obtained from the Salmonella-free closed flocks of this station. The flock had been maintained on deep-litter for the last two or three years. Between twenty-five and forty birds were used per treatment in each experiment. The chicks were wing-banded and placed at random into each group the day they were hatched. In a few experiments the chicks were weighed at different intervals in order to ascertain if the additional supplement of high levels of vitamins to the basal diet increased the growth rate and may be the food consumption. No increased growth or food consumption was noted and in consequence no attempt was made to equate food consumption between

treated and untreated groups. Food and water were supplied *ad libitum* throughout all experiments.

Experimental Diets. The experimental period was divided into two parts, a pre-inoculation period of eight weeks and a post-inoculation period of three weeks. During the first eight weeks a chick starter diet was fed and then a change was made to a growers' diet. This is in conformity with the usual practice under United Kingdom conditions. The composition of these two diets is shown in Table 1.

TABLE 1

Ingredient	Chick starter	Growers
	0 - 8 weeks	8 weeks onwards
	%	%
Ground wheat	20.0	-
" barley	20.0	24.0
Sussex ground oats	10.0	20.0
Maize meal	11.75	16.75
Middlings	15.0	25.0
Fish meal (best white)	5.0	3.0
Dec. groundnut meal	5.0	5.0
Skim milk	5.0	-
Grass meal	5.0	5.0
Unext. yeast	2.0	-
Minerals	1.25	1.25

Composition of two basal diets used in all experiments.

To both of these diets are added:—

Synthetic vitamin A 2,000 I.U./lb.
Synthetic vitamin D_3 446 I.U./lb.
Riboflavin (vitamin B_2) 1 mg./lb.

The vitamin content of these two basal diets and that of Hill and Garren (*loc. cit.*) is presented in Table 2. Obviously these figures represent only an average and have been based on various published data. The main publications consulted were those of Duckworth and Ellinger (1949), Morrison (1951), and Pritchard and Wraige (1953). The figures for biotin and pyridoxine are approximate, since one or two ingredients of our diets have not been assayed accurately. For comparison the requirements of chickens for all vitamins are included in Table 2 and are based on

the publication of the National Research Council, Washington, D.C. (1954), because no comparable British recommendations exist; these have been summarised by Cuthbertson (1957).

TABLE 2

Vitamin	Houghton diets		Basal diet of Hill & Garren	Required (per lb)	
	chick (per lb)	growers (per lb)		0-8 weeks	8-18 weeks
Thiamine (mg)	3.3	3.2	2.1	0.8	?
Riboflavin (mg)	2.6	2.0	2.5	1.3	0.8
Nicotinic acid (mg)	25.4	26.1	17.0	12.0	?
Pantothenic acid (mg)	8.5	6.6	8.4	4.2	4.2
Folic acid (mg)	8.9	4.7	1.6	0.25	?
Biotin (µg)	50?	50?	81	40	?
Pyridoxine (mg)	0.8?	?	8.7	1.3	?
Choline (mg)	540	480	1460	600	?
Vitamin B.12 (ug)	6	1.6	3.0	4.0	?
Vitamin A (I.U.)	6000	6350	4110	1200	1200
Vitamin D_3 (I.U.)	446	446	180	90	90
Menadine (mg)	?	?	10	0.2	?
Vitamin E (mg)	?	?	10	?	?

Vitamin content of the basal diets.

Hill and Garren (*loc. cit.*) in their high-level vitamin supplemented diets used pure vitamins added to a maize meal carrier and the highest levels achieved in their diet is shown in Table 3, and represented a ten-fold increase over their basal supplement. In our experiments an attempt was made to achieve approximately the same high levels with one or two exceptions. For instance, the folic acid content of our chick starter diet exceeded that of the American workers without any necessary addition of the pure vitamin. This high level was due mainly to the presence of grass meal and unextracted yeast, both of which have a high content of this vitamin. It was not possible to calculate accurately the content of biotin and pyridoxine in our basal diets, and the levels given in Table 3 represent the contribution made to the diet of 400 micrograms/lb. of biotin and 23.1 mg./lb. of pyridoxine plus the small amounts contributed by the natural materials in the basal diet. However, the added vitamins alone are high in relation to the requirements shown in Table 2.

The inclusion of vitamin C (ascorbic acid) in the experimental diets conformed with that used by the American workers who noted that this vitamin may improve

the growth of chickens (March and Biely, 1953; Briggs *et al.*, 1944) and also that it may play some function in disease resistance in certain animals (Harris, 1954).

Inoculum. In all experiments, *Salmonella gallinarum* strain 9 was employed. It was maintained on Dorset egg medium at 4° C. but when required for use it was subcultured in nutrient broth and incubated at 37° C. for 18 hours.

TABLE 3

Vitamin	Diet of Hill & Garren (mg/lb.)	Houghton diets,	
		0 - 8 weeks (per lb.)	8-11 weeks (per lb.)
Thiamine (mg)	10.2	10.2	10.2
Riboflavin (mg)	16.9	16.9	16.9
Nicotinic acid (mg)	89.0	89.0	89.0
Pantothenic acid (mg)	53.4	53.4	53.4
Folic acid (mg)	5.6	8.9	5.6
Biotin (ug)	486	450?	450?
Pyridoxine (mg)	23.1	23.1?	23.1?
Choline (mg)	7760	7760	7760
Vitamin B_{12} (ug)	30	30	30
Vitamin A. (I.U.)	31,100	31,100	31,100
Vitamin D_3 (I.U.)	1,800	1,800	1,800
Menadione (mg)	100	100	100
Vitamin E (mg)	100	100	100
Vitamin C (%)	0.1	0.1	0.1

Vitamin levels in the supplemented experimental diets.

Method of producing infection. The method of Smith (1955) was employed. Prior to inoculation the chickens were fasted for 18 hours and then given 0.1 ml. of the 18-hour broth culture standardised on every occasion to the same nephalometer reading in 1 ml. of distilled water containing 0.3 g. of an alkaline mixture.* The latter neutralised the antibacterial action of the juice in the gizzard. This amount of culture contained approximately 50 million viable bacteria. The inoculum was deposited in the œsophagus by means of a Pasteur pipette.

Housing of experimental chickens. During the first eight weeks all chicks were housed in electrically heated wire-floor brooders. At eight weeks of age the birds were transferred to fold units with wire floors and raised off the ground on concrete piers.

Dietary regimes and age at inoculation. During the first four weeks of life all birds received the basal chick mash *ad libitum*. At four or eight weeks of age certain experimental groups were fed the vitamin-supplemented diets. All birds were inoculated at eight weeks of age. The disease was then allowed to run its

* Calcium carbonate 40 per cent; colloidal kaolin 43 per cent; magnesium trisilicate 17 per cent.

natural course for 21 days after infection, after which time all survivors were killed and examined post-mortem as described by Smith (1955).

Bacteriological examination of survivors. The complete heart, approximately half the liver and about six inches of the intestine were macerated with sterile scissors into separate jars of selenite F medium and incubated for 18 hours at 37° C. The contents were then plated on to D.C.S.S. medium (Williams-Smith and Buxton, 1951) and examined for the presence of *Salmonella gallinarum.*

Results

The mortality rate in three breeds of chickens in the experimental disease. In order to ascertain the variation in response to be expected in the three breeds of chickens used in our experiments, several groups of each breed (25 to 40 per group) were reared under identical conditions at different points of time and infected with *Salmonella gallinarum.* The results are shown in Table 4.

TABLE 4

Breed	Sex	Number of Groups	Total No. of chickens infected	Deaths		Range in per cent mortality between Groups	Death from acute form		Mean survival time (days). + Standard - Error.
				Number	Per Cent		Number	per cent	
RIR	Mixed	9	344	279	81.1	56.7-100	264	94.6	9.4 ± 0.15
Br.L.	Mixed	9	297	279	93.9	74.1-100	260	93.1	9.1 ± 0.16
W.L.	Mixed	10	338	85	25.1	4.7-53.5	58	68.2	11.8 ± 0.39

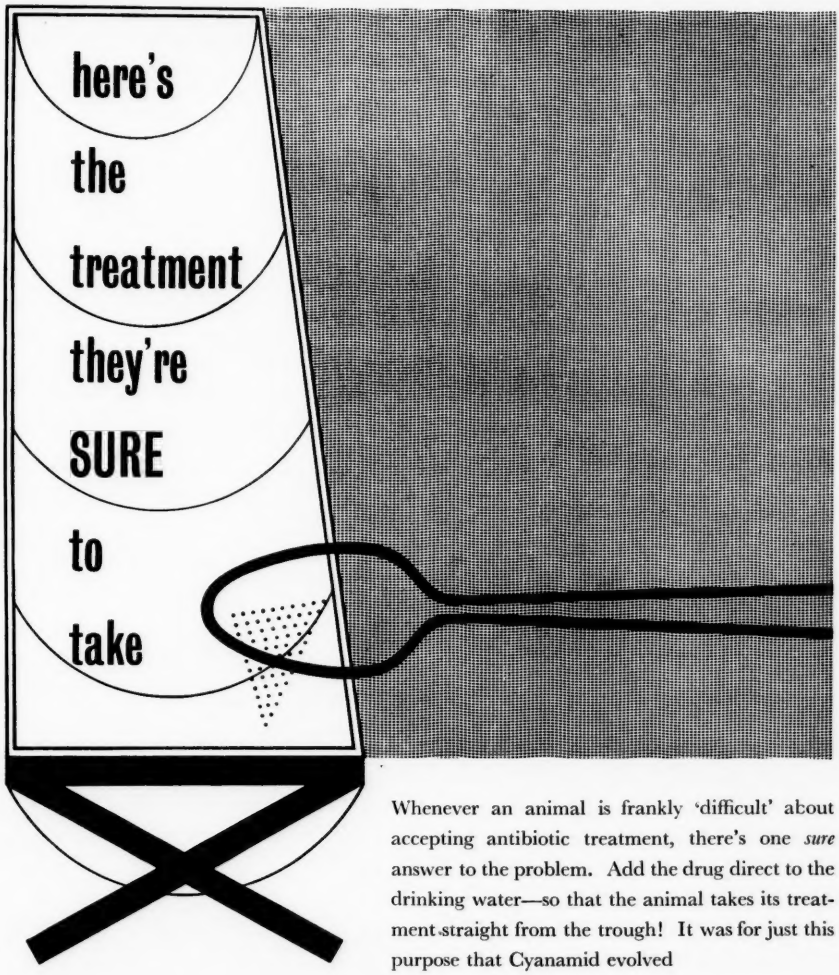
The susceptibility of three different breeds of chickens to experimental *Salmonella Gallinarum* infection.

All chickens became infected, the highest mortality occurring in the Rhode Island Reds and Brown Leghorns. There was no significant difference in the mean survival time of the Rhode Island Reds and Brown Leghorns, but considerable variation did occur in the mortality in different groups within the same breed, in spite of standardisation of environmental conditions and the use of experimental chickens from the same parents.

On the other hand, the susceptibility of the White Leghorn chickens to this infection was much lower, the average mortality for different groups ranging from the low figure of 4.7 per cent to 53.5 per cent. This lower susceptibility was reflected also in the increased survival time and lower percentage of deaths from the acute form of the disease.

Experiment 1. The purpose of the first experiment was to determine whether high levels of all the required vitamins (plus vitamin C) had any effect on the susceptibility of three different breeds of chickens to *Salmonella gallinarum* when administered in the diet immediately after infection. The results are shown in Tables 5 and 6.

Instituting the high level feeding of all the required vitamins immediately after infection with *Salmonella gallinarum* had no significant effect on the susceptibility of either Rhode Island Red or Brown Leghorn chickens judged by the mortality or mean survival time. On the other hand, there was a significant reduction in



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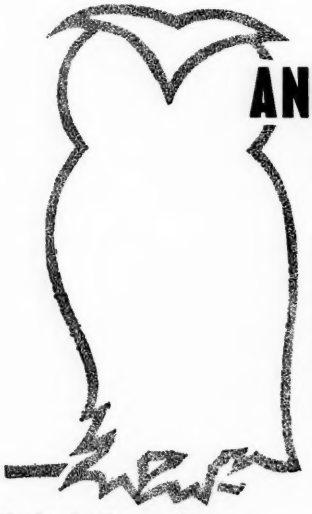

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mortality in the White Leghorns receiving high levels of all the required vitamins, although there was no significant difference in the mean survival time between

TABLE 5

Group number	Breed	Diets	Mortality		Per cent mortality from acute form	Mean survival time (days) ± S.E.
			Number	Per Cent		
1 -	R.I.R.	Basal	36/40	90.0	88.9	9.6 ± 0.47
2	R.I.R.	High Vitamin	34/40	85.0	94.1	9.4 ± 0.32
3	Br.L.	Basal	23/23	100	91.3	9.2 ± 0.32
4	Br.L.	High vitamin	21/23	91.3	100	8.3 ± 0.39
5	W.L.	Basal	18/40	45.0	61.1	11.7 ± 0.87
6	W.L.	High vitamin	10/40	25.0	40.0	12.6 ± 1.53

The effect of high levels of all the required vitamins on the susceptibility of chickens to *Salm. gallinarum* when administered at the time of the infection.

treated and untreated groups. This lowered susceptibility was confirmed in part in the survivors which on post-mortem examination showed a larger number of chicks free from lesions or infection of the tissues. In view of this finding a further

TABLE 6

Group No.	Breed	Diets	Number of survivors	Number of blood tests positive	Number of rectal swabs positive	Chronic lesions			Bacteriological examination		
						Mild	Severe	None	Intestine only	Tissue *	Neg.
1	RIR	Basal	4	4	0	0	4	0	0	0	4
2	RIR	High vits.	6	6	2	2	4	0	1	0	5
3	Br.L.	Basal	0	0	0	0	0	0	0	0	0
4	Br.L.	High vits.	2	2	0	1	1	0	0	1	1
5	W.L.	Basal	22	22	1	8	13	1	1	0	21
6	W.L.	High vits.	30	30	0	12	12	6	1	0	29

* Liver and heart.

Post-mortem and bacteriological findings in survivors of experiment 1.

group of White Leghorn chicks were infected and treated as in the first experiment. The results are presented in Table 7.

The results of this experiment failed to confirm the findings of the previous one. In fact, the reverse occurred. The average survival time of the White Leg-

horns receiving the high-vitamin supplemented food was significantly lower ($P = 1 < 0.05 > 0.02$) than the controls. The post-mortem findings on the survivors did not reveal any differences.

TABLE 7

Diet	Mortality		Per cent mortality from acute form	Mean survival time (days) ± S.E.	Number of survivors	Number of blood tests positive	Number of rectal swabs positive	Chronic lesions			Bacteriological examination		
	Number	per cent						mild	severe	none	Intestine only	Tissues*	Neg.
Basal	16/28	57.1	100	12.5±0.89	12	12	0	2	8	2	2	1	9
High Vitamins	16/29	55.2	100	9.6±0.86	13	12	0	3	9	1	6	2	5

Effect of high levels of all the required vitamins on the susceptibility of White Leghorn chickens infected with *Salmonella gallinarum* and the post-mortem and bacteriological findings of the survivors.

* Liver and heart.

Experiment 3. In the third experiment the susceptibility of three breeds of chickens was determined after they had received high levels of all the required vitamins for a period of four weeks prior to infection and during the subsequent post-inoculation period. The results are shown in Table 8 and 9.

TABLE 8

Group Number	Breed	Diets	Mortality		Per Cent mortality from acute form	Mean survival time (days) + S.E.
			Number	Per cent		
7	R.I.R.	Basal	40/43	93.0	100	8.9 ± 0.24
8	R.I.R.	High vitamin	38/40	95.0	97.4	9.3 ± 0.37
9	Br. L.	Basal	37/37	100	94.6	8.6 ± 0.44
10	Br. L.	High vitamin	33/34	97.1	100	7.5 ± 0.22
11	W.L.	Basal	17/42	40.5	76.5	11.8 ± 1.08
12	W.L.	High vitamin	32/41	78.0	100	9.8 ± 0.48

Effect of dietary high levels of vitamins on the susceptibility of tnree breeds of chickens to *Salm. gallinarum* when fed for four weeks prior to inoculation and during the subsequent post-inoculation period.

The feeding of high levels of all the required vitamins for a period of four weeks prior to infection and during the subsequent post-inoculation period did not affect the susceptibility of Rhode Island Red chickens to *Salm. gallinarum*. The same high mortality occurred in both treated and untreated controls and there was

no significant difference in the average survival time. In the Brown Leghorns, whilst there was no difference in the total mortality, there was a small but significant reduction in the average survival time ($P = <0.02 > 0.01$) of the birds receiving high levels of vitamins.

TABLE 9

Group Number	Breed	Diets	Number of survivors	Number of blood test positive	Number of rectal swabs positive	Chronic lesions			Bacteriological examination		
						Mild	Severe	None	Intestines only	Tissues	Negative
7	R.I.R.	Basal	3	3	1	2	1	0	0	0	3
8	R.I.R.	High vitamin	2	2	0	0	2	0	0	0	2
9	Br.L.	Basal	0	0	0	0	0	0	0	0	0
10	Br.L.	High vitamin	1	0	0	0	0	1	0	0	1
11	W.L.	Basal	25	23	9	12	4	1	0	0	24
12	W.L.	High vitamin	9	8	5	3	1	0	1	1	8

Post-mortem and bacteriological findings in survivors from experiment 3.

On the other hand the mortality of White Leghorn chickens receiving high levels of vitamins in their diet was nearly twice that of the group receiving the normal basal chick mash. In addition there was a small but significant reduction in their survival time ($P = <0.1 > 0.05$).

In view of the findings of Hill and Garren (*loc. cit.*) that high levels of the fat-soluble group of vitamins may increase susceptibility, the next two experiments were carried out to determine whether the increased mortality encountered in the White Leghorns may have been caused by either this group of vitamins or the water-soluble group.

Experiment 4. In this experiment high levels of the fat-soluble vitamins (A, D, E and K) were administered in the diet for four weeks prior to infection with *Salm. gallinarum* and also during the subsequent post-inoculation period. The results are shown in Tables 10 and 11.

The feeding of high levels of the fat-soluble vitamins during a four-week period prior to inoculation had no effect on the susceptibility of either Rhode Island Red or Brown Leghorn chickens judged either by total mortality or average survival time. In the White Leghorns the mortality encountered in the group receiving the high levels of vitamins was four times as high as the controls although there was no significant difference in the average survival time between the two groups. No significant difference could be detected in either group of survivors, both of which appeared to have suffered the same degree of infection. However, in view of this increase in mortality a further group of White Leghorn chicks were infected and managed as in experiment 4. The results are shown in Table 12.

The results of this experiment failed to confirm the findings of the previous one and illustrates very clearly the wide variation in susceptibility to *Salm. gallinarum* which exists between different groups of White Leghorn chickens used in this work. This group of experimental chicks proved highly resistant to infection, only 11 per

cent succumbing in each group. The mean survival time of the treated chicks was slightly less than the control group but was not statistically significant. Post-mortem examination of survivors did not reveal any evidence that high levels of the fat-soluble vitamins had influenced the severity of the infection, although cultures of the various tissues showed that 22 out of 33 (66.7 per cent) of this group were negative for *Salm. gallinarum* compared with 29 out of 34 (85.3 per cent) in the control group.

TABLE 10

Group number	Breed	Diets	Mortality		Per cent mortality from acute form	Mean survival time (days) ± S.E.
			Number	Per cent.		
13	R.I.R.	Basal	38/38	100	94.7	7.8 ± 0.20
14	R.I.R.	High vitamin	39/41	95.1	100	8.3 ± 0.14
15	Br.L.	Basal	35/35	100	100	8.7 ± 0.23
16	Br.L.	High vitamin	33/33	100	90.9	8.2 ± 0.23
17	W.L.	Basal	3/23	13.0	66.7	11.7 ± 1.47
18	W.L.	High vitamin	12/24	50.0	100	12.2 ± 0.12

Effect of dietary high levels of the fat-soluble vitamins on the susceptibility of three breeds of chickens to *Salm. gallinarum* infection when fed for four weeks prior to inoculation and during the subsequent post-inoculation period.

TABLE 11

Group Number	Breed	Diets	Number of survivors	Number of blood test positive	Number of rectal swabs positive	Chronic lesions			Bacteriological examination		
						Mild	Severe	None	Intestines only	Tissues	Negative
13	R.I.R.	Basal	0	0	0	0	0	0	0	0	0
14	R.I.R.	High vitamin	2	2	0	0	0	2	2	0	0
15	Br.L.	Basal	0	0	0	0	0	0	0	0	0
16	Br.L.	High vitamin	0	0	0	0	0	0	0	0	0
17	W.L.	Basal	20	20	1	11	8	1	1	6	9
18	W.L.	High vitamin	12	12	1	8	5	4	4	6	4

Post-mortem and bacteriological findings in survivors from experiment 4.

Experiment 5. In this final experiment, high levels of the water-soluble vitamins were administered in the diet for a period of four weeks prior to infection and during the subsequent post-inoculation period. The results are shown in Tables 13 and 14.

The inclusion of high levels of the water soluable group of vitamins (B_1, B_2,

nicotinic acid and pantothenic acid, folic acid, biotin, pyridoxine, choline and vitamin B_{12}) in the diet had no significant effect on the mortality rate or average survival time of either the Rhode Island Red or Brown Leghorn chickens. Again, the White Leghorns proved resistant to this infection, the course of which was not influenced by the presence of high levels of vitamins in the diet. Post-mortem and bacteriological findings on the survivors revealed no differences in the treated and untreated groups.

TABLE 12

Diet	Mortality		Per cent. mortality from acute form	Mean survival time (days) ± S.E.	Number of survivors	Number of blood tests positive	Number of rectal swabs positive	Chronic lesions			Bacteriological findings		
	Number	Per cent.						Mild	Severe	None	Intes. only	tissues	Negative
Basal	4/38	10.5	50	15.0± 1.54	34	31	3	7	16	11	3	2	29
High vitamin	4/37	10.8	75.0	13.5± 2.25	33	32	4	9	13	11	4	7	22

The effect of dietary high levels of the fat soluble vitamins on the susceptibility of White Leghorn chickens infected with *Salm. gallinarum.*

Discussion

Hill and Garren (*loc. cit.*) claimed to have shown that not only do high levels of all the required vitamins increase the resistance of chickens to experimental *Salm. gallinarum* infection, but that every individual vitamin at certain levels, with the exception of choline, can either increase or decrease this resistance. In addition, ascorbic acid, although not a normal dietary factor required by the chicken was shown to promote resistance to fowl typhoid when used with high levels of

TABLE 13

Group Number	Breed	Diets	Mortality		Per cent mortality from acute form	Survival Time (days) ± S.E.
			Number	Per cent		
19	R.I.R.	Basal	27/40	67.5	92.6	10.9 ± 0.51
20	R.I.R.	High vitamin	29/41	70.7	96.6	10.8 ± 0.43
21	Br.L.	Basal	40/41	97.6	95.0	9.1 ± 0.31
22	Br.L.	High vitamin	40/40	100	92.5	9.0 ± 0.31
23	W.L.	Basal	6/39	15.4	83.3	11.3 ± 0.66
24	W.L.	High vitamin	5/39	12.8	60.0	11.6 ± 0.67

The effect of high levels of the water soluble vitamins on the susceptibility of three breeds of chickens infected with *Salm. gallinarum.*

other vitamins, although alone it had no effect. These conclusions were based on small differences in survival time but no error range or significance was given and also in some cases only small differences in the percentage of survivors occurred. It has been pointed out that a large variation in the response of different breeds of chickens to an infection can occur and this variation can be quite large even between different genetic strains within a single breed. It is this difference in so-called " natural resistance " (or " suspectibility ") which makes the evaluation of results of experiments of this kind so difficult. The term " natural resistance " may be described as the difference among potential hosts, which, without previous exposure to an infection, results in a difference in response upon their initial contact to it.

TABLE 14

Group number	Breed	Diets	Number of survivors	Number of blood tests positive	Number of rectal swabs positive	Chronic lesions			Bacteriological exam.		
						Mild	Severe	None	Intestines only	Tissues	Negative
19	R.I.R.	Basal	13	13	0	1	10	2	4	8	1
20	R.I.R.	High vitamin	12	12	0	2	9	1	2	9	1
21	Br.L.	Basal	1	1	0	0	0	1	0	1	0
22	Br.L.	High vitamin	0	0	0	0	0	0	0	0	0
23	W.L.	Basal	33	33	0	9	21	3	4	25	4
24	W.L.	High vitamin	34	32	2	13	12	9	7	22	5

Post-mortem and bacteriological findings in survivors from experiment 5.

This is clearly illustrated in the work of Hill and his co-workers (*loc. cit.*) who using chicks from a commercial hatchery found a wide range of mortality to occur when infected with a standard inoculum of *Salm. gallinarum*. The range obtained by these workers varied between 39 and 90 per cent. A similar wide variation in mortality (Table 4) was observed in this series rendering the interpretation of any effects on mortality difficult. In one experiment (II), Hill and Garren (*loc. cit.*) obtained a higher mortality (84 per cent) in a group of chicks receiving high levels of vitamins compared with the untreated controls (81 per cent). In their earlier paper, Hill *et al.* (1955) have speculated on possible explanations for the dietary effects observed; in our opinion such differences did not appear to have been consistently large enough to claim that high levels of vitamins are protective against *Salm. gallinarum*.

Whilst our experiments are not strictly comparable to those of the American workers, differences occurring in breed, age at infection and type of diet fed, it was felt that if high levels of vitamins *per se* do offer some protection against the susceptibility of chickens to *Salm. gallinarum*, it would have been reflected in these reported experiments. However, in spite of the differences noted above, but with every effort made to standardise other environmental factors, often the results obtained have not been of the magnitude hoped for and on occasions contrary to the expected direction. In using two highly susceptible breeds (R.I.R. and Br.L.)

any protective influence of high level vitamin feeding might possibly be reflected in a lower mortality and less severe infection judged by post-mortem findings on survivors. On the other hand, the use of a "resistant" (or "insusceptible") breed (W.L.) may have demonstrated any potentiating effect of vitamins on this infection.

However, in the two susceptible breeds, apart from one experiment (Table 8) with Brown Leghorns, the administration of high levels of all the required vitamins in the diet at the time of infection or for four weeks prior to it, failed to alter either the mortality or average survival time of infected chickens. The arbitary splitting of the vitamins into either fat-soluble or water-soluble groups and feeding them at high levels failed to affect either the mortality or average survival time of these two breeds of chickens.

The results using White Leghorns were more variable. In the first experiment, the administration of all the required vitamins in conjunction with vitamin C at the time of infection reduced both total mortality and numbers dying from the acute form of the disease (Tables 5 and 6). On repeating this experiment, the expected reduction in mortality was reversed (Table 7), there being no difference in the mortality between the treated and untreated groups, and the average survival time was significantly reduced in the group receiving the high levels of vitamins.

This increase in susceptibility of White Leghorn chickens caused by high levels of vitamins was partially confirmed in experiment 3 (Tables 8 and 9). The mortality of the group receiving high levels of vitamins in the diet for a period of four weeks prior to infection suffered twice the mortality of the untreated controls. This increased susceptibility was also confirmed by the higher numbers dying from the acute form. Hill and Garren (*loc. cit.*) have drawn attention to the fact that high levels of the fat-soluble group of vitamins could increase total mortality and decrease the average survival time. This observation was confirmed in experiment 4 (Tables 10 and 11), but on repeating it (Table 12) this result was not confirmed.

On the other hand, high levels of the water-soluble group of vitamins were found to have no effect on the susceptibility of White Leghorn chickens to *Salm. gallinarum* infection (Tables 13 and 14).

Speculation on these conflicting results and possible explanations of them would not be of much value in the absence of confirmatory experimental evidence. In experiments of this nature cognizance must be taken of wide variation in response which may be exhibited by different breeds of chickens. Consequently, great rigidity is required in standardising experimental details; and it is obvious that small and as yet unmeasurable factors affect the result. This would suggest that unless inbred lines of uniform susceptibility are used in conjunction with purified diets and careful records of food consumption, only confused facts will emerge.

Summary

1. The effect of feeding high levels of all the required vitamins on the susceptibility of three breeds of chickens to experimental *Salm. gallinarum* infection has been investigated.

2. Apart from one experiment, neither the administration of high levels of all

the required vitamins in the diet for four weeks prior to infection or at infection had any effect on the average survival time or total mortality in 8-week-old Rhode Island Red or Brown Leghorn chickens.

3. The separation of the vitamins into the fat-soluble or water-soluble groups and their administration in the diet at high levels for four weeks prior to infection had no effect on the average survival time or total mortality in Rhode Island Red or Brown Leghorn chickens.

4. With White Leghorn chickens infected with *Salm. gallinarum* a great variation in response to the high level feeding of vitamins was encountered. Some results would suggest that the feeding of high levels of vitamins for four weeks prior to infection may increase the suspectibility of this breed to *Salm. gallinarum* and this may possibly be associated with the fat-soluble group (A, D, E and K).

5. The problems associated with investigations into the inter-relationship of nutrition and disease and some of the variables encountered in experiments with poultry are discussed.

Acknowledgements

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NOTES ON THE USE OF CALCIUM DISODIUM VERSENATE IN HEAVY METAL POISONING OF LIVESTOCK

By E. F. LEWIS, M.R.C.V.S.
Royal Veterinary College, Streatley
and J. C. MEIKLE, M.R.C.V.S.
Reading

NUMEROUS opportunities still occur whereby animals may receive toxic doses of lead, while poisoning by certain other heavy metals such as copper and mercury is encountered occasionally. Until recently, no satisfactory treatment existed except to attempt to precipitate the metal in the alimentary tract as an insoluble compound. Many attempts have been made to find a substance which would combine with the poisonous metal and render it inert, facilitate its excretion or make it so harmless that it could be deposited in the tissues without causing trouble. In the main, these proved unsatisfactory because the antidote was excreted either before combining with the toxic agent in sufficient amount to be of value or the new compound formed was dangerously toxic also. The first reports by Holm *et al.* (1955), Lewis and Meikle (1956) and Todd (1957) on the value of a new complexing agent in cases of lead poisoning in cattle and horses are therefore of interest to clinicians. The chelating substance used was Calcium disodium ethylene-diamine tetra-acetate or " Calcium Disodium Versenate ".

Chelation

The property of chelation is possessed by a few chemical substances such as nitrogen, oxygen or sulphur which are capable of donation electrons. They can form very stable ring structures with metals which are so strongly combined that they are not ionised and do not show any of their normal chemical reactions. Natural examples of chelation occur in chlorophyll (chelated magnesium) and hæmogloblin (chelated iron).

Probably one of the best and most potent synthetic chelating agents is ethylene-diamine tetra-acetic acid (EDTA). Unfortunately the use of this acid or its sodium derivative in animals would lead to hypocalcæmia. In consequence in the treat-meat of heavy metal poisoning, EDTA is used in the form of its mono-calcium, disodium salt in which the calcium-chelating activity is saturated but from which the calcium is displaced by heavy metals readily.

Pharmacology of Calcium Disodium Versenate (" Ca-EDTA ")

According to Foreman *et al.* (1953) some two-thirds of a dose of Ca-EDTA given intravenously is excreted within 6 hours and most of the reminder within 24 hours. A small proportion is voided in fæces.

While Ca-EDTA combines in the body with metals capable of displacing the Calcium, the normal body content of the same metals is unaffected since the latter are already part of more stable complexes. This is of particular significance with regard to iron and cobalt, and administration of Ca-EDTA should not produce anæmia or derangement of Vitamin B_{12} metabolism.

The lack of any interference with the normal calcium content of bovine blood is illustrated in the table which records the results of the intravenous administration of Ca-EDTA.

In each case a dose of Calcium disodium versenate, 25 g. in 5 per cent solution, was given by slow intravenous injection. The blood calcium levels were estimated by the method described by Kramer and Tisdall (1921 and 1923).

6 year-old Guernsey Cow		7 year-old Jersey Cow	
Before admin. ...	10.6 mg. Ca % serum	Before admin. ...	11.2 mg. Ca % serum
15 mins after ...	10.5 ,, ,, ,,	15 mins after ...	11.3 ,, ,, ,,
30 mins after ...	10.5 ,, ,, ,,	30 mins after ...	11.1 ,, ,, ,,
60 mins after ...	10.6 ,, ,, ,,	60 mins after ...	11.2 ,, ,, ,,
Neither animal was pregnant and no milk had been secreted for at least a year			

The safety margin is reported to be very wide and doses of up to 3 grams per kilo have been given experimentally without fatality.

Clinical Applications

The chief value of the use of Ca-EDTA lies in the treatment of acute lead poisoning which appears to be the more common type experienced in most species of farm livestock. In the human field numerous references now exist to support the successful use of Ca-EDTA in the treatment of lead poisoning and lead encephalopathy and the drug has been used against other heavy metals. Sidbury (1953) used it in acute and chronic mercurial poisoning in children. There is some indication that acute copper poisoning in animals may be prevented by the oral administration of Ca-EDTA in areas where copper contamination of pasture has occurred.

One aspect of the subject which, it is hoped, will remain of academic interest only is the use of Ca-EDTA in removing radio-active substances absorbed into the animal body. This applies particularly to nuclear fission products having a long biological half-life and presenting a chronic toxicity hazard. Cohn *et al.* (1953) demonstrated the efficacy of Ca-EDTA in removing Yttrium 91 used as a test substance from the soft tissues of rats and, in combination with Disodium dihydrogen versenate, from bone after deposition. Vaughan and Tutt (1953) also report favourably on the use of Ca-EDTA in extracting radio-active fission products from the bodies of rats.

Administration

Blaxter (1950) reported that the lethal dose of lead given intravenously in the sheep is between 200-400 mg. Allcroft and Blaxter (1950) demonstrated the toxicity of lead for cattle to be of the same order and from this, Todd (1957) calculated that at least 10 to 20 g. of Ca-EDTA would be required to combine with a lethal dose of lead.

It has been found in practice that a dose rate of approximately 1 g. for every 30 lb. body weight provides adequate chelation in acute cases and the drug is con-

veniently supplied for veterinary use in bottles of 25 g. dissolved in 100 c.c. of water. The estimated dose should be diluted with sufficient, sterile normal saline or gluco-saline solution to give a final dilution of approximately 5 per cent. This should be given by slow, intravenous injection and usually it is advisable to follow initial treatment with a second dose after an interval of a few days.

Unabsorbed lead in the alimentary system is rendered partly inert by the administration of soluble sulphates by mouth, but oral doses of Ca-EDTA may be given to produce this effect.

The results of treatment of cases of acute lead poisoning in cattle reported by Lewis and Meikle (1956) and Todd (1957) support the findings of Holm and his co-workers that in calcium disodium versenate veterinary surgeons have an effective means of overcoming a serious toxicological problem. It is interesting to note that in two animals seen by the authors, which were pregnant at the time they were poisoned by lead, death of the fœtus with mummification resulted despite the successful treatment of the cow with Ca-EDTA. Pasfield (1956) suggested that this phenomenon was not an uncommon accompaniment to lead poisoning of pregnant cattle. Treatment with Ca-EDTA should be applied extremely early in such a syndrome to reduce the risk of fœtal death due to lead intoxication.

The extension of therapy with Ca-EDTA to other types of heavy metal poisoning should be considered in view of the reported success of the drug in lead and mercury intoxication.

Acknowledgements

The authors wish to thank Messrs. Riker Laboratories, Loughborough, suppliers of calcium disodium versenate for assistance in the preparation of this paper.

Summary

A brief review is given of the phenomenon of chelation and its application to heavy metal poisoning of livestock. The pharmacology, clinical applications and method of administration are also briefly discussed.

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AN ELECTRONIC STETHOSCOPE

By E. KELVIN PRICE and JOHN STRATTON

Department of Medicine, Royal Veterinary College, London

Introduction

RECENTLY Taylor and Fothergill (1956) designed an electronic stethoscope* and its application as an aid to auscultation and diagnosis in man was discussed by Wilson, Fothergill and Taylor (1956). Through the courtesy of the manufacturers the authors were able to use the instrument on various domesticated animals.

Description and Use of the Instrument

The stethoscope consists of a miniature battery operated amplifier, contact microphone and conventional earpieces (see photograph). The amplifier is very compact (12.1×7.6×6.4 cm.) and light (708.8 g.), and is carried suspended from the neck. There are two output sockets so that two observers can use earpieces at the same time. There are two input sockets and two microphones can be used simultaneously if desired. The contact microphone is insensitive to outside noise, but external noises which resonate in the animal body will be picked up.

The instrument is simple to operate. There are four controls, an on/off switch, a volume control and two attenuators. One attenuator is for high frequencies and the other for low frequencies; these attenuators are used to select the frequency band desired.

Auscultation of the Heart and Lungs

E.K.P. uses a binaural stethoscope with a rubber chest piece. The rubber reduces the amount of noise occasioned by the hair. J.S. prefers to use a binaural stethoscope with a vulcanite chestpiece. Although this does not reduce the amount of noise from the hair, the chest sounds are more clear and crisp. This difference in type of chestpiece is a matter of personal preference. Neither of us uses a phonendscope in routine clinical work, although we agree that it is useful in certain cases. Equally we dislike the small phonendoscope type of chestpiece found on some stethoscopes.

The normal stethoscope and the electronic stethoscope were used by the authors in the clinical examination of domestic animals. Two sets of earpieces were used so that the two observers could listen simultaneously. There was a certain measure of disagreement regarding the sounds which were heard. It was thought that there might be some differences in the auditory reception of the two operators. Audiographic tests were made in order to settle this point. It was found that both had normal hearing over the normal range and that the difference of opinion was due to the use of different terms in describing the sounds.

In the examination of the horse and ox the direct naked ear method was used also. Both authors often use this method to check the findings of the ordinary stethoscope.

The first model of this electronic stethoscope was found to be most useful in the examination of the heart and respiratory sounds of the dog and cat, but its

* The "Soniscope" electronic stethoscope. Airsonic Limited (Medical Division), 14 Old Queen Street, London, S.W.1.

performance was disappointing when used upon the larger animals. The instrument was unable to amplify the low frequency sounds produced by the heart of the ox and horse. The model now available is modified so that this disadvantage is minimised. Cats and dogs of all sizes were examined. Cattle varying in size from calves to an adult Friesian bull were examined and horses up to the size of a 16 hands hunter. One pig was examined and the heart sounds were amplified in a satisfactory manner. Provided an animal will remain relatively still, the heart and lungs can be auscultated satisfactorily with this electronic stethoscope. The sounds resemble closely those heard with the conventional stethoscope, except that they are louder. E.K.P. is of the opinion that the quality of the sounds may be modified by the instrument, although not to any significant extent. The contact microphone produces very little hair noise.

The results of auscultation of the chest in one series of animals using the normal binaural stethoscope and the electronic stethoscope are summarised in the table. The table shows how closely the performance of the electronic stethoscope parallels that of the ordinary binaural stethoscope in the detection and recognition of normal chest sounds. If the electronic stethoscope can detect a sound, it can be amplified to any desired level without loss of recognition.

TABLE

ANIMAL	Numbers of Animals	INSTRUMENT	Number of Animals in which chest sounds detected and recognised		
			Heart Sounds	Bronchial Sounds	Vesicular Sounds
Horse	3	Ordinary Stethoscope	3	3	0
		Electronic Stethoscope	3	2	0
Adult Cattle	5	Ordinary Stethoscope	5	5	1
		Electronic Stethoscope	5	5	0
Calves 2 - 6 months old	7	Ordinary Stethoscope	7	6	2
		Electronic Stethoscope	7	7	4
Pig	1	Ordinary Stethoscope	1	0	0
		Electronic Stethoscope	1	0	0
Dog	3	Ordinary Stethoscope	3	3	1
		Electronic Stethoscope	3	3	0
Cat	1	Ordinary Stethoscope	1	1	1
		Electronic Stethoscope	1	1	1

NOTE: The cat in this series was suffering from bronchiectasis.

Detection and Recognition of Normal Heart Sounds.

Discussion

The amplification of a recognisable chest sound renders interpretation and diagnosis easier because the observer does not have to strain to catch a faint whisper but can relax and study the sounds. The ability to study chest sounds in this way opens up new possibilities in diagnosis. Hitherto inaudible sounds may be detected by this instrument and studied. They may have some clinical significance.

Obviously a prolonged clinical trial is necessary before one can evaluate the significance of any new tones or sound that may be heard.

No sheep or goats were included in this investigation but there is no reason to suppose that there would be any great difficulty encountered in the examination of these animals than with the conventional stethoscope. Only one pig was examined. The pig does not lend itself to an examination with any type of amplifying stethoscope as it is almost impossible to keep the animal still without employing restraint, to which a pig usually objects in a very audible manner.

The authors suggest that this instrument has considerable potential as a diagnostic instrument but further experience is necessary before this can be evaluated fully. In man it is of value in the detection of fœtal heart sounds and in the auscultation of joints and tendons. The authors have not used the instrument for these purposes in animals.

There is no doubt that the instrument may be most useful to veterinary surgeons who are hard of hearing. More headsets can be connected by using a special junction box and so the apparatus could be used for teaching purposes. The instrument may be connected to a tape recorder or other recording apparatus and permanent records made of normal and abnormal thoracic sounds.

Summary

An electronic stethoscope is described. The use of this instrument in veterinary diagnosis is discussed.

Acknowledgements

The authors express their thanks to Messrs. Airsonic Limited for kindly loaning the instrument, and to the staff of the Royal Ear Hospital for the audiographic examinations.

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OBITUARY

Mr. T. A. Longmore

ALL who knew him, will learn with great regret of the sudden death in December of Mr. T. A. Longmore.

Mr. Longmore was very well known in the field of radiography. He was with Kodak Limited for 28 years. Since 1946, he had been responsible for the Medical Sales Laboratory at Kodak House, Kingsway.

During the 1939-45 war, Mr. Longmore served in the army and played a major part in training army radiographers.

He took a keen and active interest in the Society of Radiographers and he achieved every major distinction that the Society could offer. He was elected to the Presidency in 1954. He was a gifted writer and for many years the editor of the Society's journal " Radiography ".

REVIEWS

ROBERT BAKEWELL, PIONEER LIVESTOCK BREEDER, by H. Cecil Pawson, M.B.E., M.Sc., F.R.S.E. London: Crosby Lockwood & Son, Ltd. 25s.

IT is freely acknowledged that Britain is the nursery of the best livestock in the world and all nations turn to these islands when they want to replenish, fortify and upgrade the quality of their native stock. Why is Britain in this fortunate position? It is because our people have always been mindful of their beasts and have an eye for a good animal be it horse, dog, sheep or pig. They have not been content only with numbers and by selective breeding quality has been given just regard. The magnificent specimens which are to be seen today on our farms and in our stables are the direct result of a continuous urge and effort to improve. If we would seek for a time when stock improvement made its most spectacular surge and when the primary principles on which all subsequent improvements have been based were first conceived obviously that time would be the eighteenth and nineteenth centuries and the eighteenth would be reckoned as the most important of the two. It was in this period that the primary requirements of quality for the various breeds and species were fixed. Indigenous types were standardised as to quality and form and by sagacious cross-breeding experiments new types were evolved and fixed with a view to satisfying the eye and hand and the economic desires of breeders, purchasers and consumers. As a rule good form is synonymous with good quality. For all these things, and incidentally for the continued improvement of our stocks, we owe our greatest debt to one man and he was Robert Bakewell, a farmer of Dishley Grange, near Loughborough in Leicestershire. Robert Bakewell had not the advantage to possess the deep scientific knowledge which is available to a breeder in the twentieth century. By modern standards his experiments and researches would be considered empirical; but were they so empirical? He had an eye for good shape and form, he knew that like bred like, he appreciated that by this means one could evolve and fix type, he was gifted with a great fund of common sense and judgment, he had the courage to follow his ideas on long-term projects and he must also have been gifted with the type of intuition which can predict and almost impel success. Many of his conceptions and findings have been justified and proved correct by subsequent scientific research. His work has given impetus to the science of animal husbandry for science can work backwards as well as forwards and, as in many other walks of life, the empirical finding of a useful fact has been the bait which has intrigued the research worker and stimulated him to try to find out how or why it has happened. Robert Bakewell's name should be held in reverence by all who are interested in or live by animal husbandry and we are in great debt to Professor Pawson for his historical research and for making available an account of the life and work of a remarkable man. All who turn the pages of this book will find interest and profit and I am sure that many of the most avid readers will be members of the veterinary profession.

VET IN THE MAKING, by Nancy Martin, London: Macmillan & Co. 8s. 6d. net.

WE may have read of the adventures of Ricky and Vanda on Mr. Kelly's farm in Nancy Martin's book "Call the Vet". We may remember also Mr. Harvey the Veterinary Surgeon and his son Bill and how Ricky's mind turned to the idea

of a career in Veterinary Science. This book tells the story of his escapades, trials and tribulations during his undergraduate days at Rushton University Veterinary School. Ricky is one of the lucky ones for the authorities consider that his prowess in Chemistry, Physics and Biology at advanced level at school was sufficient to allow of his exemption from the drudgery of the first year's course and examinations. Probably they were right for even if he had been called to do them again most of the knowledge would have lapsed from his memory in a month after the examination. As many other students have done, Ricky got into bad company on his first day at College, indeed he had not even arrived at the place when he was involved in an accident and precipitated under the influence of two time-wasting and irresponsible students, Tom and Eddie. His friend, Bill Harvey, a senior student, tries to guide him on to the right track but to no avail. Sport and good times almost wreck his College career but as in all good stories the hero mends his ways and triumphs in the end and graduates B.V.M.S.

To those who are ill informed this book, whilst telling an interesting and somewhat romantic story, will show that a veterinary surgeon's training is severe and comprehensive and of a standard similar to that of a graduate in other branches of science. To those who are well informed and particularly those who have experienced the course it will bring back memories of strenuous yet happy days and memory being kind they may sigh nostalgically and wish that they could put the clock back.

Fenimore Cooper thrilled and incited his youthful readers to follow a life of adventure on the frontiers and in the backwoods. Nancy Martin's tale may cause her youthful readers to flock to the veterinary colleges in search of adventure and/or matrimony.

SYMPOSIUM OF TUBERCULOSIS. Edited by Professor F. R. G. Heaf. Pp. xvi + 755, numerous tables, figures and plates. London: Cassell & Co. £5 5s.

IN any subject where there exists an extensive and ever increasing literature the appearance of a comprehensive work of reference is welcome. In that respect *Symposium of Tuberculosis*, by presenting a wealth of information in one volume, fulfills to a great extent the needs of those engaged in the varied branches of the tuberculosis problem. As the foreword suggests it will be valuable, especially to those engaged where a medical library is not easily accessible.

The book is the product of fourteen authors, distinguished in their own fields. Professor Heaf is the editor and a contributor of three chapters. Though dealing mainly with human tuberculosis it contains much of interest and value to the veterinary reader.

The first chapters are devoted to general considerations, infection and immunity, the prevalence and prevention of tuberculosis. One chapter of forty pages written by Professor John Francis deals with tuberculosis in animals. In the introduction to this chapter the author points out that it was not possible to treat the subeject adequately in the present volume. A survey of bovine tuberculosis forms the major portion of this section, the detection and control of the disease and milk legislation receiving considerable attention. Shorter accounts of tuberculosis in numerous other species complete this chapter.

This is a valuable contribution to the Symposium. There are, however, a few minor criticisms. Although it is stated that relatively few references are given it is a little surprising to find no mention of the great and early fundamental work of A. S. Griffith.

In the part dealing with meat inspection one is left in doubt as to the importance of the occurrence of tubercle bacilli in muscle. On page 283, quoting M'Fadyean's experiment where meat taken with strict aseptic precautions from tuberculous animals failed to infect rabbits and guinea-pigs it is stated "This therefore supports the evidence that infection of the blood and flesh is rare even in advanced tuberculosis." On the following page, in a discussion on forms of tuberculosis indicating a breakdown of resistance evidenced by dry caseous masses interspersed with blood spots, appears the statement "the lesions pour a continuous supply of bacilli into the blood stream and the muscular tissue becomes extensively invaded." Incidentally, the memorandum on meat inspection in Great Britain, in use for a long time, Memo 62 Foods, has since 1952 been replaced by Memo 3 Meat.

One wonders what evidence exists for the statement made in the section on tuberculosis in dogs that "Short nosed breeds such as fox terriers appear to be more susceptible than others, and males are more commonly affected than females".

Despite those few anomalies many, including the medical man and veterinary student, will find this chapter most useful in gaining a wide background knowledge of tuberculosis in animals and it will also focus attention on the importance of animals as reservoirs of infection for, excepting bovine tuberculosis, this fact has not been emphasised adequately hitherto.

The remainder of the book is devoted to respiratory and non-respiratory tuberculosis, tuberculosis in children and a consideration of the disease as it occurs in the tropics and in industry. The last chapter deals with rehabilitation.

There is an excellent index, the illustrations are of a high standard and the production is good.

It is a tome which can be read with profit by all who are interested in this important subject.

BIOCHEMICAL CONTRIBUTIONS TO ENDOCRINOLOGY, by Sir Charles Dodds, M.V.O. Stanford University Press, Stanford, California. Oxford University Press, Pp. 76. Illustrated. 18s.

THIS book consists of the five Lane Medical Lectures for 1956, delivered at Stanford University by Sir Charles Dodds, in which he presented an outline of the brilliant research work carried out by himself and his colleagues over the last 30 years.

Following a historical introduction, the biological effects of dinitrophenol on basal metabolism and tissue respiration are discussed.

He then describes researches on the isolation of a pituitary fraction (identified with Vasopressin) which produces lesions in the gastric mucosa of rabbits.

The chief topic discussed concerns the researches leading to the synthesis of Stilbœstrol and Hexœstrol, and the relation between chemical constitutions and biological activity of the Oestrogen.

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Lastly, studies of the adrenal cortex are described, including work on the isolation and biological properties of Aldosterone.

Throughout, emphasis is laid on the fact that research initially in the field of biochemistry has yielded results of great practical importance for agriculture, and human and veterinary medicine.

The material is treated from a historical and experimental point of view, which will be valued by students of endocrinology whether they are interested in biochemistry or physiology. Postgraduate workers will find the comprehensive reference list of especial value.

An improvement in the arrangement of the subject matter might have been achieved by omitting the original division into lectures.

NOTICES

BURROUGHS WELLCOME & Co. announce that Mr. H. B. Lomas, M.P.S., Manager of the Sales Department (Veterinary) and formerly Manager of Burroughs Wellcome & Co. (Middle East), is now General Sales Manager (Veterinary Division).

EVANS MEDICAL SUPPLIES LIMITED announce the development of a new product, an improved Lamb Dysentery Vaccine, capable of stimulating in ewes a high level of active immunity against *Cl. welchii* types B and D in a dose of 2 ml. It is claimed that the absence of bacterial bodies in this vaccine ensures safety, guaranteed potency and reduced risk of local reaction at the site of injection.

"Maxilume" Radiograph Illuminators

"MAXILUME" illuminators for examining radiographs up to 14 in. × 17 in. (35 × 43 cm.) have recently been introduced by Newton Victor Ltd., X-ray department of Metropolitan-Vickers. The new design incorporates many improvements ensuring greater accuracy and convenience for the critical examination of X-ray negatives.

A feature of the illuminators is the use of 15-watt colour-matching fluorescent lamps giving an evenly diffused, glareless light of true north daylight character with a complete absence of flicker. These are fitted in an efficient reflector with a special plastics diffuser panel of high light transmission characteristics.

The illuminators are of strong welded sheet steel construction in an attractive cream vellum stoved finish and are supplied wired, complete with two 15-watt, 18 in. fluorescent lamps, lampholders, auxiliary control gear, rotary switches, and 6 ft. of mains cable, for operation from 200/250 volts, 40/60 cs A.C.

The film to be examined is held in position by means of a ball type film holder mounted in a clear Perspex bar which enables the very top edge of the film to be seen. This important feature of the new design ensures easy trouble-free insertion, and firm retention of the negative without scratching or marking.

The narrow back to front measurement of 4½ in. is a valuable asset for surface or recessed wall mounting and the absence of any surround to the viewing panel allows the illuminators to be banked side by side with the diffuser panels touching, to form multiple banks of any desired number with individual control and freedom

from dark spaces between viewing panels. If desired, they can also be mounted one above the other.

A removable supporting foot is provided at the back to ensure stability for desk or shelf mounting; keyhole slots in the back allow for wall mounting.

The units when standing on a desk tilt back at just the right angle for comfortable viewing.

As very little heat is given off by the fluorescent lamps, units may be safely recessed without special ventilation.

When heavier densities up to 2.5 are to be examined, the illuminator can be fitted internally with a high-intensity photoflood lamp so arranged that the fluorescent tubes are switched off when the photoflood lamp is used.

A dimming device can also be supplied, in which case an extra control switch is provided on the front panel as shown in the illustrations.

The dimming device provides a means of regulating light intensity from full down to 15% of maximum. The rotary control on the front of the illuminator, next to the on/off mains switch, reduces intensity to 75% and 60% in two steps and then continuously to 15%. The illumination from the viewing panel remains uniform with complete absence of irritating flicker and "instant starting" is possible at the reduced intensities.

To avoid risk of damaging the wet film by accidental contact with the illuminator, and to prevent water entering the illuminator itself, a one-piece plastics panel can be supplied with the lower end of the panel moulded to form a channel to catch drips from the wet films. The panel is quickly slipped over two chromium plated supports fitted to the upper part of the illuminator. These same supports carry the film hanger so that the film is held clear of the illuminator panel.

By the use of a special frame mounting, the standard Newton Victor triple roller-blind masking set can be used with the illuminators. The frame is fixed permanently to the body of the illuminator by two chromium-headed screws and the roller-blind masking set is mounted on the frame.

By reducing the illuminated area and eliminating the extraneous marginal light, smaller radiographs or particular portions of large radiograhs can be viewed and fine detail examined critically without eyestrain.

Illuminators and accessories are available from stock.

Second International Symposium on Freezing and Drying

THE Institute of Biology is arranging a symposium on Freezing and Drying to discuss progress in this field since the first symposium held in 1951. The meeting is to be held in the Beveridge Hall, Senate House, London, W.C.1, on April 1 and 2, 1958. Some twenty speakers, including workers from France, Japan, Kenya, the U.S.A. and the U.S.S.R., have accepted invitations.

The symposium will be open to all persons interested and a programme can be obtained from the Institute of Biology, 41 Queen's Gate, London, S.W.7.

NEWS

Ernest Cotchin, D.Sc., M.R.C.V.S.

ON 29th January, 1958, the Senate of the University of London awarded the Degree of Doctor of Science on Ernest Cotchin for his work in the field of "Veterinary Science: Pathology with particular reference to Neoplasia in domestic animals".

Dr. Cotchin's honour will give great pleasure to his colleagues, students past and present and to his many friends in the veterinary profession.

It puts a hall mark on a worker who has earned the respect and regard of his peers and by his skill and erudition has proved worthy to follow in the steps of the great McFadyean.

Agricultural Scholarships

THE Ministry of Agriculture, Fisheries and Food is offering a limited number of scholarships for courses in agricultural or allied subjects, including veterinary science, at university departments of agriculture, agricultural colleges and farm institutes. Amongst them are.

Twenty Senior Scholarships for degree or diploma courses in an agricultural subject (degree courses at university departments of agriculture, diploma courses at the agricultural colleges and the Essex and Lancashire Institutes of Agriculture); or for courses in veterinary science at veterinary colleges.

Large-Animal Surgery

A COURSE of two lectures on "Problems Associated With Large-Animal Surgery", by Professor J. G. Wright, Dean of the Faculty of Veterinary Science and Professor of Veterinary Surgery in the University of Liverpool, will be given at the Royal Veterinary College at 4 p.m. on February 21st and 28th. The titles of the lectures will be "Equine Anæsthesia" and "Bovine Dystocia". At the first lecture the chair will be taken by Dr. K. G. Lloyd-Williams, Dean of the Royal Free Hospital School of Medicine and Dean of the Faculty of Medicine in the University of London.

The lectures are addressed to students of the University and to others interested in the subject; admission is free, without ticket.

The Royal Society of Health Congress

THE Royal Society of Health Congress is being held this year at Eastbourne from April 28th to May 2nd.

Professor Lovell of the Royal Veterinary College has been elected this year's President of the Veterinary Hygiene Section and the programme is taking the form of a Symposium, "Some Lesser-known Diseases Common to Man and Animals". This will take place on Wednesday, April 30th, from 2.30 p.m. to 5.30 p.m. The subjects will be:—

"Bacterial Infections" by J. A. Boycott, M.A., D.M., M.R.C.S., L.R.C.P., Director, Public Health Laboratory (Medical Research Council), Taunton;

"Virus Infections" by F. O. MacCallum, B.Sc., M.D., L.M.S., Virus Reference Laboratory, Central Public Health Laboratory (Medical Research Council);

"Parasitic Infestations" by E. L. Taylor, C.B.E., D.V.Sc., M.R.C.V.S., D.V.H., N.D.A., N.D.D., Deputy Director, Ministry of Agriculture Veterinary Laboratories, Weybridge;

The discussions will be opened by Mr. W. Tweed, F.R.C.V.S., D.V.S.M., of the Ministry of Agriculture, Dr. J. F. Warin, M.D., D.P.H., Medical Officer of Health, City of Oxford, and Mr. E. H. C. Wadhams, M.A.P.H.I., A.M.I.P.H.E., Chief Public Health Inspector, Witham Urban District Council.

The President of the Congress will be the Minister of Health.